

To all our customers

Regarding the change of names mentioned in the document, such as Mitsubishi Electric and Mitsubishi XX, to Renesas Technology Corp.

The semiconductor operations of Hitachi and Mitsubishi Electric were transferred to Renesas Technology Corporation on April 1st 2003. These operations include microcomputer, logic, analog and discrete devices, and memory chips other than DRAMs (flash memory, SRAMs etc.) Accordingly, although Mitsubishi Electric, Mitsubishi Electric Corporation, Mitsubishi Semiconductors, and other Mitsubishi brand names are mentioned in the document, these names have in fact all been changed to Renesas Technology Corp. Thank you for your understanding. Except for our corporate trademark, logo and corporate statement, no changes whatsoever have been made to the contents of the document, and these changes do not constitute any alteration to the contents of the document itself.

Note : Mitsubishi Electric will continue the business operations of high frequency & optical devices and power devices.

Renesas Technology Corp.
Customer Support Dept.
April 1, 2003

M51945A,B/M51946A,B**VOLTAGE DETECTING, SYSTEM RESETTNG IC SERIES****DESCRIPTION**

M51945A,B/M51946A,B are semiconductor integrated circuits designed for input voltage detection and for resetting of all types of logic circuits such as CPUs.

Possible applications are extensive, including circuits for battery checking, level detecting and waveform shaping.

FEATURES

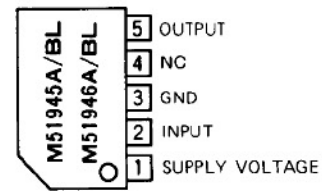
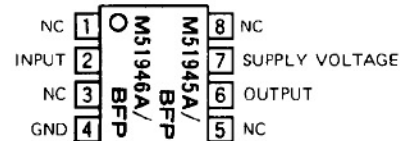
- Few external parts
- Low threshold operating voltage (Supply voltage to keep low-state at low supply voltage) 0.6V (TYP.) at $R_L = 22k\Omega$
- Wide supply voltage range 2 ~ 17V
- Sudden change in power supply has minimal effect on the ICs
- Wide operation range of detecting input pin Narrower ranges of $-0.3V \sim V_{CC}$ or $-0.3V \sim 7V$ (Input voltage detecting type)
- Suitable for high supply voltage circuit with simple circuit structure (M51945B, M51946B)
- Permits easy configuration of a circuit for protection against reverse connection or surges. (M51945B, M51946B)
- Wide application range
- SIL package of the same height as DIP (5-pin SIP)

APPLICATION

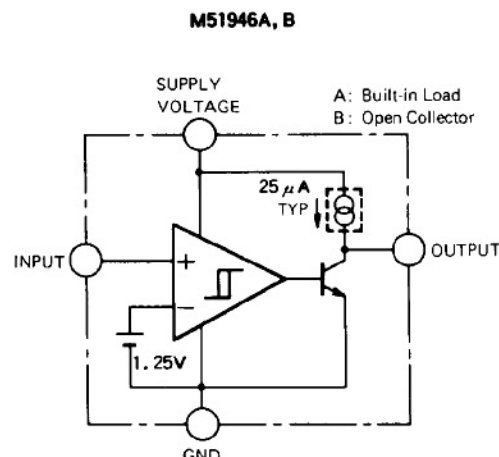
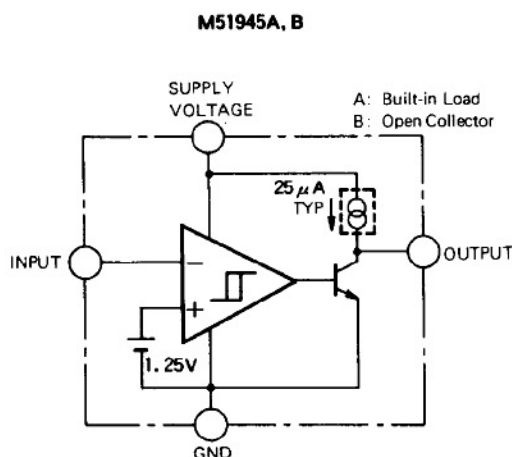
Reset circuit of Pch, Nch, CMOS, microcomputer, CPU and microcomputer, Reset of logic circuit, Battery check circuit, Switching circuit back-up voltage, Level detecting circuit, Waveform shaping circuit, Delay waveform generating circuit, DC-DC converter, Over voltage protection circuit.

RECOMMENDED OPERATING CONDITION

Supply voltage range 2 ~ 17V

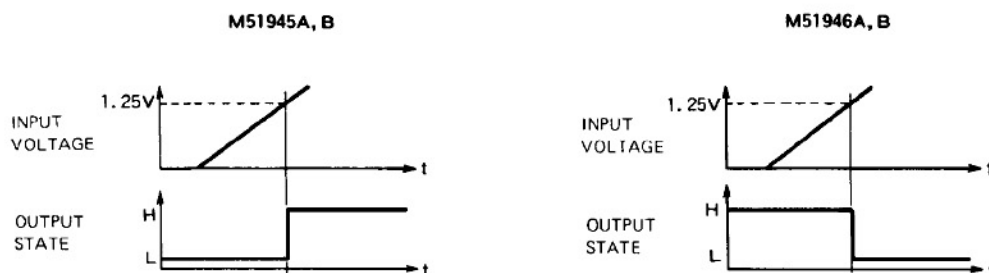
PIN CONFIGURATION (TOP VIEW)**Outline 5P5T****Outline 8P2S-A**

NC: NO CONNECTION

BLOCK DIAGRAM

VOLTAGE DETECTING, SYSTEM RESETTNG IC SERIES

FUNCTION DIAGRAM



ABSOLUTE MAXIMUM RATINGS ($T_a = 25^\circ\text{C}$, unless otherwise noted)

Symbol	Parameter	Conditions		Ratings	Unit
V _{CC}	Supply voltage			18	V
I _{sink}	Output Sink Current			6	mA
V _O	Output voltage	A Type (Output with constant current load)		V _{CC}	V
		B Type (Open collector output)		18	
P _D	Power dissipation	5P SIP		450	mW
		8P SOP		300	
K _θ	Thermal Derating	Ta ≥ 25℃	5P SIP	4.5	mW/℃
			8P SOP	3	
T _{opr}	Operating temperature			-30 ~ +85	℃
T _{stg}	Storage temperature			-40 ~ +125	℃

ELECTRICAL CHARACTERISTICS ($T_a = 25^\circ\text{C}$, unless otherwise noted)

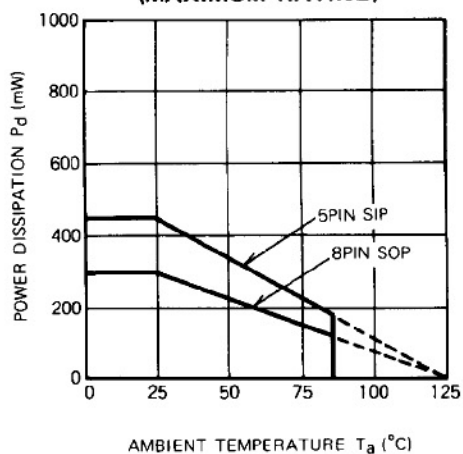
"L" reset type	"H" reset type
M51945A	M51946A
M51945B	M51946B

Symbol	Parameter	Test condition	Limits			Unit
			Min	Typ	Max	
V_S	Detecting voltage		1.20	1.25	1.30	V
ΔV_S	Hysteresis voltage	$V_{CC} = 5V$	9	15	23	mV
$V_S/\Delta T$	Detecting Voltage Temperature Coefficient		—	0.01	—	%/ $^\circ\text{C}$
V_{CC}	Supply Voltage Range	$T_a = -30 \sim +85^\circ\text{C}$	2	—	17	V
V_{IN}	Input voltage Range	$T_a = -30 \sim +85^\circ\text{C}$, $V_{CC} \leq 7V$	-0.3	—	V_{CC}	V
		$T_a = -30 \sim +85^\circ\text{C}$, $V_{CC} > 7V$	-0.3	—	7	
I_{IN}	Input Current	$V_{IN} = 1.25V$	—	100	500	nA
I_{CC}	Circuit Current	Type A $V_{CC} = 5V$	—	310	470	μA
		Type B $V_{CC} = 5V$	—	280	420	
V_{sat}	Output Saturation Voltage	L reset type $V_{CC} = 5V$, $V_{IN} < 1.2V$, $I_{sink} = 4mA$	—	0.2	0.4	V
		H reset type $V_{CC} = 5V$, $V_{IN} > 1.35V$, $I_{sink} = 4mA$	—	—	—	
V_{OPL}	Threshold Operating Voltage	L reset type minimum supply voltage for IC operation	$R_L = 2.2k\Omega$, $V_{sat} \leq 0.4V$	0.67	0.8	V
			$R_L = 100k\Omega$, $V_{sat} \leq 0.4V$	0.55	0.7	
I_{OH}	Output Leakage Current	Type B	—	—	30	nA
		Type B, $T_a = -30 \sim +85^\circ\text{C}$	—	—	1	μA
I_{OC}	Output Load Current	Type A $V_{CC} = 5V$, $V_O = 1/2 V_{CC}$	-40	-25	-17	μA
V_{OH}	Output High Voltage	Type A	$V_{CC} - 0.2$	$V_{CC} - 0.06$	—	V
t_{PHL}	Propagation Delay Time	Response time when V_{CC} changes H $\rightarrow$ L	—	4	—	μs
t_{PLH}		Response time when V_{CC} changes L $\rightarrow$ H	—	2	—	μs

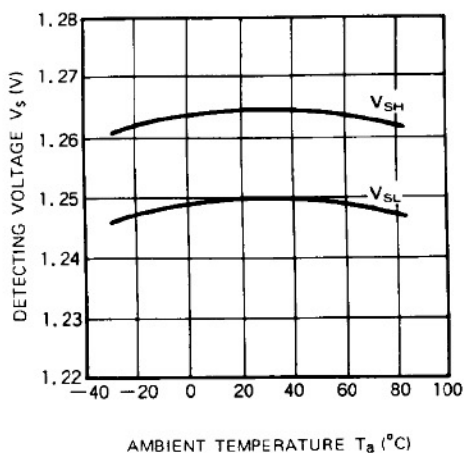
VOLTAGE DETECTING, SYSTEM RESETTIC IC SERIES

TYPICAL CHARACTERISTICS

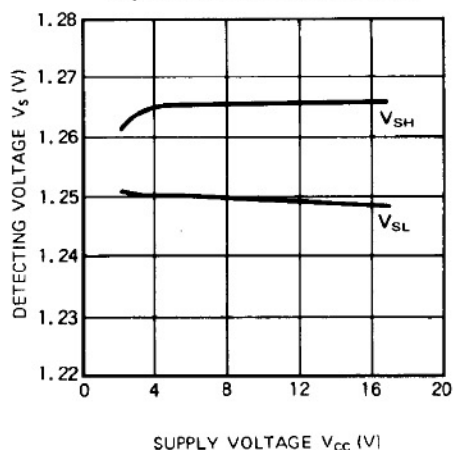
**TYPICAL CHARACTERISTICS
THERMAL DERATING
(MAXIMUM RATING)**



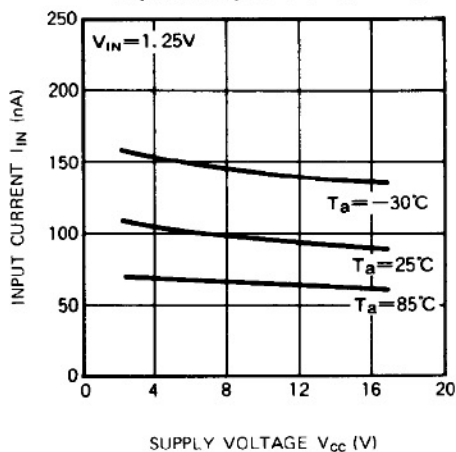
**DETECTING VOLTAGE VS.
AMBIENT TEMPERATURE
(Input voltage detecting series)**



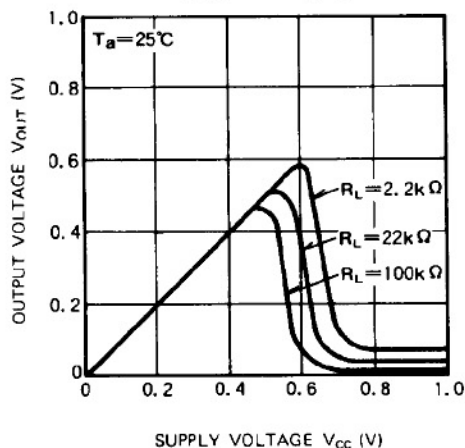
**DETECTION VOLTAGE VS.
SUPPLY VOLTAGE
(Input voltage detection series)**



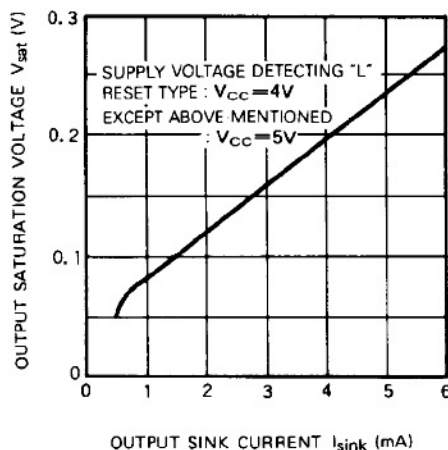
**INPUT CURRENT VS.
SUPPLY VOLTAGE
(Input voltage detecting series)**



**THRESHOLD OPERATING VOLTAGE
([L] reset type)**

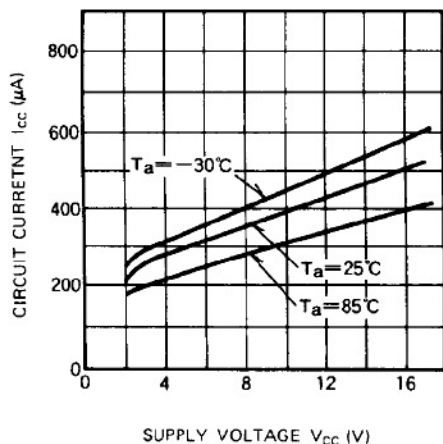


**OUTPUT SATURATION VOLTAGE VS.
OUTPUT SINK CURRENT**

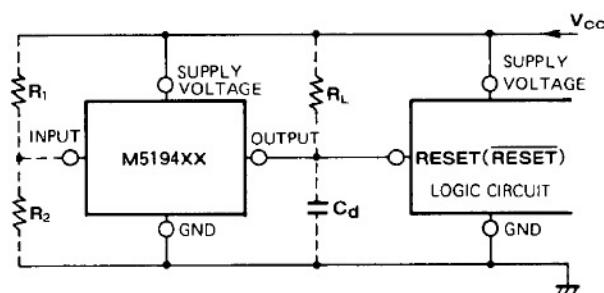


VOLTAGE DETECTING, SYSTEM RESETTIC IC SERIES

**CIRCUIT CURRENT VS.
SUPPLY VOLTAGE
(M51945B, M51946B)**



EXAMPLE OF APPLICATION CIRCUIT
Reset Circuit of M5194XX Series



Note 1. When the detecting supply voltage is 4.25V, M51943 and M51944 are used and R_1 and R_2 are not necessary.

When the voltage is anything except 4.25V, M51945 and M51946 are used. In this case, the detecting supply voltage is $1.25 \times \frac{(R_1 + R_2)}{R_2}$ (V) approximately. The detecting supply voltage can be set between 2V and 15V.

Note 2. If the M5194XX and the logic circuit share a common power source, type A (built-in load type) can be used whether a pull-up resistor is included in the logic circuit or not.

Note 3. The logic circuit preferably should not have a pull-down resistor, but if one is present, add load resistor R_L to overcome the pull-down resistor.

Note 4. It is better to use the M5195XX series to cause a delay, but if the delay is caused by the M5194XX series, the delay capacitor C_d is applied between the output and GND.

Note 5. When the reset terminal in the logic circuit is of the low reset type, M51943 and M51945 are used and when the terminal is of the high reset type, M51944 and M51946 are used.

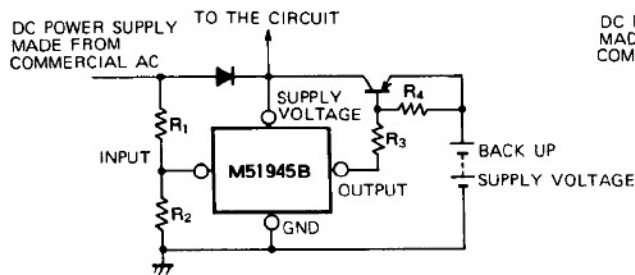
Note 6. When a delay is necessary at both rise time and fall time, M51945 and M51946 are used and the series resistors (R_{11} , R_{12}) are applied between the output and GND or instead of R_1 , and these connect the capacitor between the connection point and GND. The connection point of the capacitor is fixed according to the ratio of delay at fall/rise time.

Note 7. When a negative supply voltage is used, the supply voltage side of M5194XX and the GND side are connected to GND and the negative supply voltage respectively.

VOLTAGE DETECTING, SYSTEM RESETTNG IC SERIES

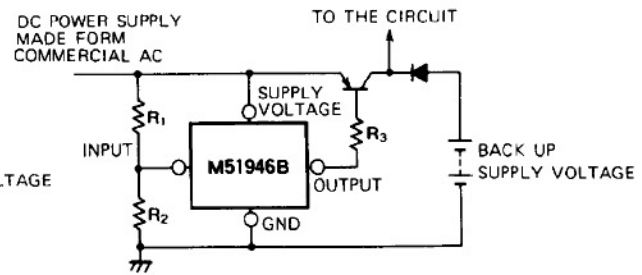
Switching Circuit to Back-up Power Supply

(a)



$$\text{SWITCHING VOLTAGE} \approx 1.25 \times \frac{R_1 + R_2}{R_2} (\text{V})$$

(b)

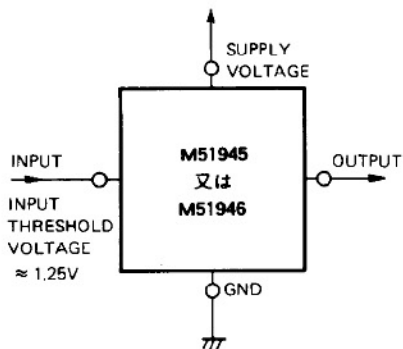


$$\text{SWITCHING VOLTAGE} \approx 1.25 \times \frac{R_1 + R_2}{R_2} (\text{V})$$

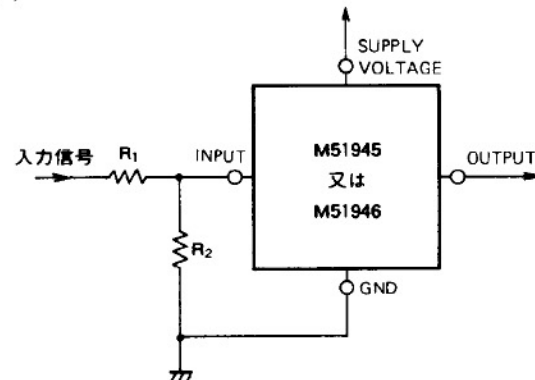
Level Detecting Circuit, Waveform Shaping Circuit

Because the input threshold of M51945 and M51946 is little dependent on supply voltage and temperature and has hysteresis of 15mV approximately, these ICs can be used in level detecting circuits and waveform shaping circuits.

(a)



(b)

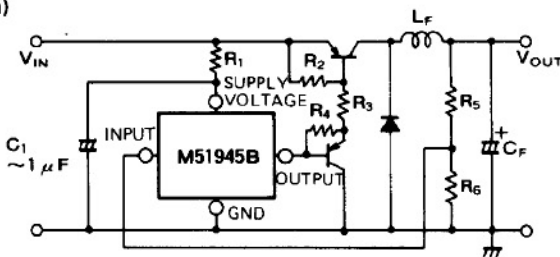


$$\text{THRESHOLD VOLTAGE} \approx 1.25 \times \frac{R_1 + R_2}{R_2} (\text{V})$$

DC-DC Converter

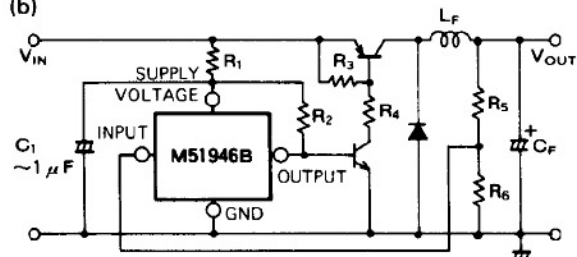
Step Down Regulator

(a)



$$V_{OUT} \approx 1.25 \times \frac{R_5 \times R_6}{R_6} (\text{V})$$

(b)

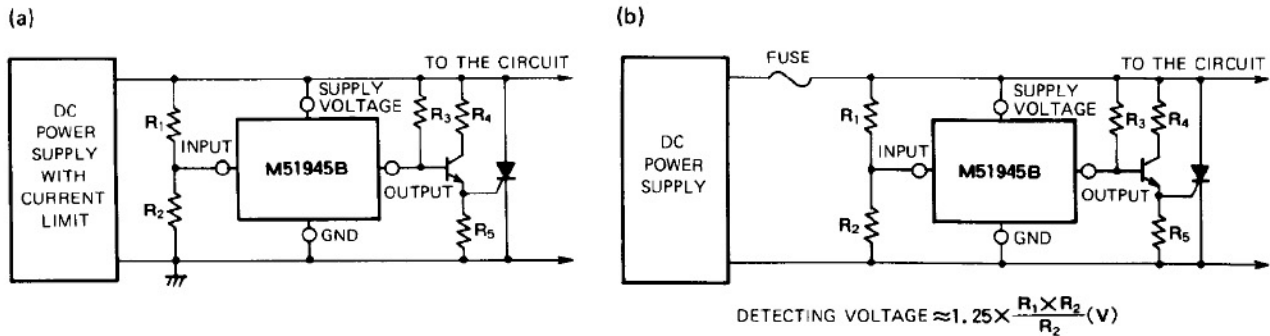


$$V_{OUT} \approx 1.25 \times \frac{R_5 \times R_6}{R_6} (\text{V})$$

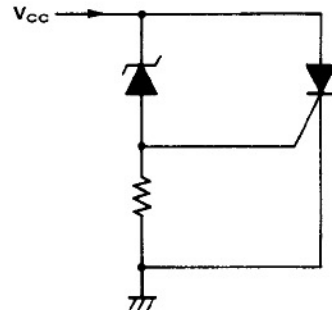
In (b) above, the power supply for M51946B is provided by both R_1 and R_2 (and the M51946B internal resistor) and so a high input voltage can be used.

VOLTAGE DETECTING, SYSTEM RESETTNG IC SERIES

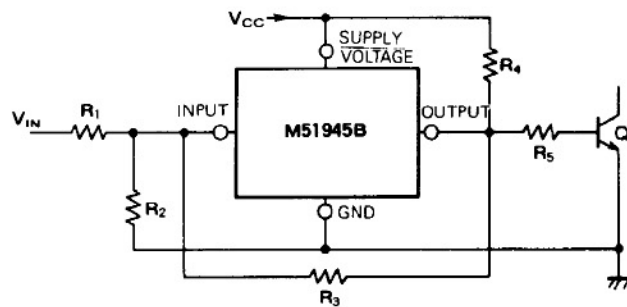
Over Voltage "Crowbar" Circuit



The over voltage "crowbar" circuit, using a zener diode as shown below, offers lower drive capacity and decreases the capacity for di/dt of SCR. (Enough gate current is needed to turn on SCR.)



Expansion of Hysteresis Using M51945B



Q_1 : OFF $\rightarrow$ ON

Threshold voltage

$$= \frac{(R_1 + R_2)}{R_2 \cdot R_3} [1.265(V) \cdot (R_1 // R_2 + R_3) - V_{sat} \cdot (R_1 // R_2)]$$

Q_1 : ON $\rightarrow$ OFF

Threshold voltage

$$= \frac{(R_1 + R_2)}{R_2 \cdot (R_3 + R_4 // R_5)} \cdot [1.25(V) \cdot (R_3 + R_1 // R_2 + R_4 // R_5) - \frac{R_1 // R_2}{R_4 + R_5} \cdot (R_4 \cdot V_{BE1} + R_5 \cdot V_{cc})]$$

Where V_{sat} : M51945B output saturation voltage

V_{BE1} : Base-emitter voltage $\approx 0.7V$ (Transistor Q_1)

$$R_1 // R_2 \equiv \frac{R_1 \cdot R_2}{R_1 + R_2}, \quad R_4 // R_5 \equiv \frac{R_4 \cdot R_5}{R_4 + R_5}$$

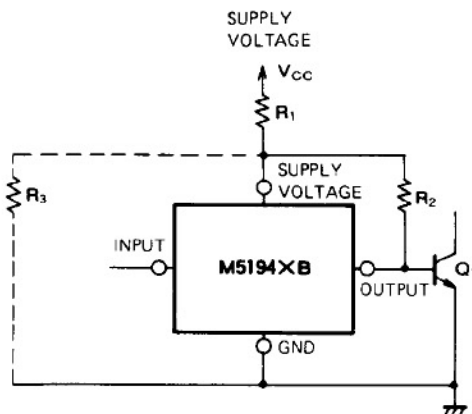
M51945A,B/M51946A,B

VOLTAGE DETECTING, SYSTEM RESETTNG IC SERIES

Application to High Supply Voltage Circuit

The absolute maximum rating of supply voltage for M51945B, M51946B is 18V. By diving supply voltage using

resistors, these ICs can be used in high supply voltage circuit.



In the above figure, the voltage applied to M5194XB is as follows. The voltage range is set between 2V and 17V.

$$\text{at } Q_1 \text{ ON: } \frac{R_2 \cdot \left[\frac{R_3}{(R_1 + R_3)} \cdot V_{CC} - (R_1 // R_3) \cdot I_{CC} \right] + (R_1 // R_3) \cdot V_{BE1}}{R_2 + (R_1 // R_3)}$$

$$\text{at } Q_1 \text{ OFF: } \frac{R_2 \cdot \left[\frac{R_3}{(R_1 + R_3)} \cdot V_{CC} - (R_1 // R_3) \cdot I_{CC} \right]}{R_2 + (R_1 // R_3)}$$

$$R_1 // R_3 \equiv \frac{R_1 \cdot R_3}{R_1 + R_3}$$

V_{CC} : Circuit current of M5194XB

V_{BE1} : Base-emitter voltage $\approx 0.7V$ (Transistor Q_1)

This circuit provides reverse protection (in case of reverse connection of power supply) and surge protection. Using this application circuit, the directly rectified or

smoothing commercial voltage can be applied as shown below.

